

THE INSTITUTE OF PHYSICS

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A NEW YEAR MESSAGE FROM THE PRESIDENT

The first atomic bomb produced in this country was exploded last October. This brings home to us the progress which has already taken place in large scale atomic research in this country.

The use of nuclear fission for the production of industrial power is now being actively pursued and the physicist is playing a major role in this development. Large and new opportunities for our profession will arise in industry as the application of atomic science expands.

The Institute is thriving and its prestige and influence continue to increase.

I send you my best wishes for 1953.

C Sykes

NOTICES TO MEMBERS

Bournemouth Convention

Arrangements for the Institute Convention at Bournemouth on May 27th-30th, 1953, are nearly complete. Notices and forms of application will be sent to all members early in March. Members hoping to attend are reminded that they need make no private reservations of accommodation; provisional bookings have already been made on behalf of the Institute and accommodation at a range of prices will be available through the Institute.

In addition to the three principal lectures, by Dr. A. C. Menzies ("Recent Developments in Applied Optics"), Sir John Cockcroft ("Recent Advances in Nuclear Physics") and Dr. C. E. Raven ("The Impact of Physics on Science and Religion"), lectures and discussions will be organized by the Institute's Groups. A choice of technical visits, visits for ladies and social activities will be available.

This Convention will be the biggest conference ever organized by the Institute and it is expected that at least 500 members and guests will attend. The Board particularly hopes that many younger members and their ladies will be able to be present and that senior members will consider sympathetically requests from their staff for leave of absence for this purpose.

Non-members of the Institute may attend only as guests of members. A conference fee will be charged to non-members other than members' ladies.

Conference on Static Electrification

The Institute Conference on Static Electrification is to be held at Bedford College, Regent's Park, London, on March

25-27, 1953. Forms of application to attend are now available and may be obtained from the Institute or from Honorary Secretaries of Branches. Accommodation is limited and early application should be made (the last date for the return of forms is February 20); preference will be given to members of the Institute. Preprints of the papers will be available to those attending.

List of Meetings

A booklet of meetings to be held in the second half of the 1952-53 session will be circulated to members during January. Additional copies are available on request.

Training of Industrial Radiographers

At the request of the Board, following proposals by the Committee of the Institute's Industrial Radiology Group, the City and Guilds of London Institute agreed to set up an Exploratory Committee to consider education and training in industrial radiography and the possible establishment of certificates awardable by the City and Guilds of London Institute. The Committee held its first meeting on December 18, at the Institute's House and has set up a sub-committee to draft syllabuses. In addition to the three Institute of Physics representatives (Mr. W. E. Schall, Mr. F. Y. Poynton and Mr. N. Clarke), the following Members of the Institute represent other organizations on the Committee: Dr. A. Harvey, Mr. H. S. Barlow, Dr. J. E. Smith, H.M.I., Mr. C. Croxson and Dr. A. Nemet.

NATIONAL CERTIFICATE COURSES IN APPLIED PHYSICS

By Dr. J. TOPPING, F.Inst.P. (Vice-President)

This paper was prepared at the request of the Association of Technical Institutions and presented at the Annual Meeting of the Association on February 22, 1952. It has since been slightly modified to bring it up to date and is reprinted here with the Association's permission.

National Certificates in various branches of engineering have been established for many years, but it was as recently as 1945 that a scheme for the establishment of National Certificates in Applied Physics was approved by the Ministry of Education and the Institute of Physics. The first examinations were held only in 1947 but perhaps sufficient experience has already been accumulated on which to base a survey of the scheme and to venture some comments on its possible development.

Before discussing the courses in some detail, it will be well to consider how the scheme arose and some of the industrial needs which gave rise to it.

Physicists in Industry.

The applications of physics in industry are manifold, for physics is a fundamental science and consequently of basic importance in many technologies. Physicists are therefore widely engaged in industry and in industrial research laboratories, but it is only comparatively recently that adequate recognition has been accorded to them. Earlier a physicist was often styled an engineer or a chemist, and only very tardily has he been allowed to exist under his own name and in his own right. Thus in 1936, when the Institute of Physics arranged a discussion, attended by representatives of the Universities, industrial firms, research associations and Government establishments, on the training of industrial physicists several speakers asked for the definition of "a physicist."

This could hardly happen to-day when physicists are working in almost every branch of industry as well as in the Scientific Civil Service. Their work in spectacular fields like that of atomic energy is common knowledge (even if some of their results are on the secret list!), but elsewhere in the electrical industry, in iron and steel, in hospitals, in the research associations, in optics, in instrument firms and in many other industries they are now indispensable. This work is not only distributed over the various branches of physics, but it varies considerably from industry to industry and from firm to firm, and often ranges widely in a particular laboratory. Some physicists are engaged entirely on research problems often indistinguishable from the pure research usually associated with the Universities, some are concerned with development work and others with instrumentation, testing, and measurements; they are part of the "scientific" and "experimental" staff of industry, and the majority of them are University-trained. They have working with and alongside them a larger number of technical assistants, who have usually entered industry, as laboratory assistants or "student"-assistants, straight from school. It is from this group that many of the part-time students of physics in Technical Colleges are drawn, and it is hoped that more and more of them will be attracted to the National Certificate courses in applied physics. Previously some of them had no alternative but to follow a National Certificate course in engineering or in chemistry, but neither of these really catered for their special needs.

It was the war of 1939-45 that showed up very starkly the needs of industry for men trained in physics, and caused the Institute of Physics to think anew and fundamentally about the education and training of physicists. Out of these considerations the present scheme for National Certificates in

applied physics was born. On looking back it is not surprising that the first proposal to establish these National Certificate courses, as early as 1923, had to be laid aside as premature. But negotiations started in 1943 were fruitful and culminated in the Ministry of Education inviting the Institute to undertake the functions and duties usually assigned to a professional institution in a scheme for the award of National Certificates. The Joint Committee of the Institute and the Ministry appointed to administer the scheme first met in January, 1945. In Scotland a similar Joint Committee was set up in October, 1949, at the request of the Scottish Education Department. The two Committees work independently but are in close touch; minutes are circulated among both committees and the Deputy Secretary of the Institute is secretary of both.

Along with these new awards have come certain changes in the regulations for membership of the Institute of Physics which have widened the way into the profession. Earlier there was only one avenue into the profession of physics and that led through the Universities. In order to become a corporate member of the Institute of Physics one had to hold a University degree in physics or at least a University degree with physics as one of the principal subjects. It became clear, with the widening of the categories of industrial physicist which has been noted earlier, that entry into the profession had to be modified particularly to cater for some of the boys and girls who go into industry straight from school and subsequently follow some system of part-time education. Only comparatively few of these are able to obtain a University degree through attendance at part-time courses in a Technical College, but some have been successful and indeed a few have attained important positions as physicists. It is hoped that many more of them will be able to follow successfully a course leading to a Higher National Certificate in Applied Physics.

Those who do not hold a University degree are now able to qualify for membership of the Institute by passing* the Graduateship examination which has recently been introduced. Holders of a Higher National Certificate in applied physics are exempt from two-thirds of the papers of this examination, and are thus grouped with holders of certain University degrees who do not qualify for full exemption. The National Certificate courses therefore may enable a boy or girl, who for various reasons has not gone to a University, to enter the profession of physics and gain professional recognition by his fellows. Already a few have done so.

The Courses and Examinations.

National Certificate courses in applied physics are now established at certain approved Technical Colleges in various parts of the country. Some colleges have courses for the Ordinary National Certificate only, but a few others have also been able to organise courses for the Higher National Certificate. The total number of students is still small, as the table shows, but considerable expansion is expected in the next few years as the courses become consolidated and other Colleges are able to make provision for them.

* there are additional conditions

Numbers of colleges presenting candidates and of certificates awarded

Year	Ordinary Certificate			Higher Certificate		
	Colleges	Candidates	Certificates	Colleges	Candidates	Certificates
1947	1	2	2			
1948	1	2	2			
1949	7	42	29			
1950	12	69	44	1	6	4
1951	12	111	59	5	29	25
1952	13	137	68	7	33	20

The senior courses leading to the Ordinary certificate are part-time courses of study extending over at least three years and include mathematics, chemistry, workshop practice and drawing as well as physics and applied physics.

The advanced courses leading to the Higher certificate are also part-time; they extend over at least two years and include mathematics, physics and applied physics.

Entrants to the first year of the senior course should have had full-time continuous education up to the age of 16, or if they have left school earlier should have completed satisfactorily a junior part-time course of two years' duration. In fact, quite a number of the students have come from Grammar Schools and some have been granted exemption from parts of the senior course on their achievement in the School Certificate or Higher School Certificate examinations. Other partial exemptions have been given to students who have completed part or whole of a different kind of National Certificate course.

During the senior course students are required to pass unassessed examinations in physics, mathematics, chemistry, workshop practice and drawing, and at the end of the third year to pass assessed examinations in mathematics, physics and applied physics. To qualify for the award of a certificate a candidate must also satisfy certain conditions concerning attendances, homework and laboratory work.

Similar conditions hold for the advanced courses and the assessed examinations for the Higher Certificate are in mathematics, physics and applied physics.

Aims and Content of the Courses.

In the senior courses classes in workshop practice and drawing occupy an important place. They are designed to acquaint the student with the use of ordinary workshop tools and with the techniques employed in working wood, metal and glass, and also to enable him to prepare and understand the working drawings necessary in this and similar work. It is not intended that the course should be the same as for engineering students; it should be in some ways wider and less specialised. An acquaintance with the methods and the possibilities is perhaps more important than the acquisition of skills in certain techniques.

But, of course, it is desirable that an assistant to a physicist should have some mechanical skill for, besides other advantages, there is often a valuable saving of time if the assistant can make small pieces of apparatus himself or effect minor modifications to the apparatus being used. On the other hand, if the apparatus has to be made by a skilled mechanic, it is important that the assistant should be sufficiently acquainted with the uses and limitations of machine tools and with the

conventions and complexities of drawings to be able to discuss the work intelligently with skilled mechanics and draughtsmen.

Often students in these courses have opportunities in their day-to-day work of using hand and machine tools, and some laboratories plan to give their assistants definite training. For instance, at the research laboratories of the Associated Electrical Industries at Aldermaston the following arrangements are made.

"After appointment the boy is released for a full day per week to take the Applied Physics Course (this Course also involves some evening classes), the remainder of his time being devoted to training in laboratory and workshop methods. The first six months of this are spent in the workshops learning to use hand tools and later machine tools. The permanent members of the workshops are appointed as members of the laboratory staff and they are all chosen for their versatility; a great variety of types of equipment has to be made and it is seldom that more than one of a particular piece of apparatus is required. The workshop staff have shown as much interest in the training scheme as have the scientists and without their co-operation it would not have been possible to help the juniors to the same extent. Each boy is placed in the charge of a skilled laboratory mechanic and a boy may work with two or perhaps three men during his time in the workshops. Because of the variety of work the boy learns several times as rapidly as he would in a more normal apprenticeship at an engineering works; at the end of the six months, the boys, whilst by no means craftsmen, are, nevertheless, well grounded in workshop methods. In addition the boy also spends about three months' full time in the drawing office.

After the initial workshop training, the boy starts to learn other techniques. Usually he spends three monthly periods learning some or all of the following: vacuum practice, electronic wiring, glass-blowing—if he has any aptitude for it—and photography. These periods are interspersed with periods in the laboratories, where he picks up various general laboratory techniques depending on the type of work in progress."

These conditions are probably exceptional, but they do illustrate the ends in view.

The other ancillary subject is chemistry, for which again it is designed that the syllabus shall be wide rather than deep, that the content of the course shall be selected with the special needs of the physicist in mind and shall, for instance, because of the various materials a physicist may have to deal with, include some elementary organic chemistry.

Mathematics and Physics.

The main subjects of the courses are mathematics and physics, including applied physics; they are main subjects for vocational reasons, but handled appropriately they can be of supreme value educationally. Indeed, the senior course will be of greater worth the less specialised it is.

Our aim in the teaching of these subjects is two-fold; firstly, it is to help the students to acquire a knowledge of physics and of some of the applications of physics in industry, and secondly, in so doing to help them to appreciate the scientific approach to a problem, how a physicist tackles the new and unknown, and how he expresses a scientific answer to a question. This second purpose is the more difficult to achieve; it cannot be enshrined in a syllabus, but it should permeate all the teaching, and particularly the teaching of mathematics.

* Dr. W. Hirst, F.Inst.P. "The Training of Assistants in a Research Physical Laboratory," this Bulletin, November, 1951.

In the mathematics courses therefore it is important to teach the basic techniques in algebra, trigonometry and the calculus, not as they would be taught to the mathematical specialist, but through the practical and the concrete. Naturally emphasis will be placed on the particular techniques physicists use and so some branches of pure mathematics will be inevitably excluded. But it is essential to do *more*, namely, to show how mathematics is used in physics, how the physicist translates the fundamental assumptions, the laws of nature, into mathematical terms, and conversely, how a mathematical equation which represents a physical situation can also be expressed in ordinary language. The importance of this will be obvious when it is remembered that a physicist is not satisfied with a mere collection of experimental results; in trying to understand the particular phenomena he is examining he attempts to express the physical situation in mathematical terms; he thus gets one or more mathematical equations which have to be "solved," that is, certain definite mathematical techniques have to be applied to them the result of which, sometimes naively called "the answer," is of little value until it is translated back again into the language of physics.

It is clear therefore that co-operation between the teacher of mathematics and the teacher of physics is essential, and that there is no simple division of functions between them. But the teacher of mathematics will teach the basic techniques using numerous applications, constantly applying the techniques to simple physical problems and so illuminating their value and power. The teacher of physics will also deal with these applications, and will devote due time and care to the mathematical formulation of physical principles and to the physical interpretation of the mathematical equations subsequently derived; otherwise the mathematical processes are a meaningless jumble which confuses and misleads.

The mathematics course besides having an orthodox content should include some work on the various methods of approximation and successive approximation, which can be introduced at all levels in the teaching of mathematics, even at the most elementary. This can be linked with valuable work on "errors of observation," which should be of great help in the physics classes, for many students have little or no idea how to estimate the error in a result derived from measurements made in the laboratory. An introduction to statistical methods should also be given, more especially in the advanced course.

In the senior course the physics syllabus has selections from all the main branches of the subject, whilst the applied physics is chiefly concerned with physical measurements in industry and therefore includes industrial methods of temperature measurement, vacuum tube devices, spectrum analysis, radiography and methods of testing the common physical properties of different materials. Physics and applied physics are often taught separately and by different teachers; specialists from industry sometimes teach the applied physics. But much would probably be gained from teaching the content of our syllabuses in physics and applied physics as one subject, call it what you will.* Not only is a division somewhat artificial and rather arbitrary, but it may have a deleterious effect on the teaching of physics which, for National Certificate students particularly, should be constantly fertilized by using practical

examples. The union of pure and applied physics should help the teacher and stimulate the student. In the advanced course, however, the nature of the specialization is such as to justify the use of the term "applied." The syllabuses of the advanced courses in applied physics at the various Colleges are moulded by the nature of local industry, but they have a common core; many of them include a fair amount of electronics and high vacuum technology, whilst others deal with one or more of such subjects as fluid flow, measurement of stress and strain, acoustics, industrial spectroscopy and X-ray technology.

There is a tendency in all syllabuses, but especially in syllabuses dealing with some particular industrial process, to try to include a little more; overloading is a real danger. It is necessary constantly to examine whether one is attempting to deal with too many facts to the neglect of the understanding of principles. Moreover, time in evening classes in Technical Colleges is so limited that one always has to try to ensure that the important matters are dealt with and the inessentials left out. There will be disagreement about the "inessentials," but generally it will be accepted that the understanding of the principles of physics is what is desired rather than mere knowledge of facts. It is therefore necessary to be careful that overweighing with facts does not conceal the basic principles and concepts.

It is perhaps worth remarking here that basic principles as well as the elements of scientific method can be taught with very simple facts and without assuming any great mathematical equipment. Indeed, the mathematical theory, though important, should occupy a secondary place. It is the phenomena which are primary, and insight into them the great gift which some physicists have pre-eminently. We probably cannot teach physical insight, but we can help the students to develop an appreciation of it by a clear exposition in non-mathematical terms of the physical ideas involved in the phenomena under discussion. Too often students do not realise that the mathematics only expresses the physical ideas which are the starting point of any theory. Difficulties which are usually imagined to be mathematical are often due to lack of clarity in the physical picture.

Another danger is to try to do what industry alone can do. In their work these National Certificate students are gaining experience of the techniques of physics applied in industry and no Technical College can hope, or should attempt, to reproduce industrial conditions. What a Technical College can do is to guide the students into an understanding of physics and into an appreciation of its method and of the value of careful measurements.

In these National Certificate courses then one would like to see physics taught as a whole, using not necessarily the traditional sequence, but an unorthodox approach through practical applications; further, one would welcome an emphasis on the expression in clear language of the basic physical ideas and secondarily on their mathematical formulation, whilst much could be done, linked with the mathematics courses, on errors and principles of measurement. Gaps in factual knowledge there will inevitably be, but these will be more easily filled later if the basic principles are understood.

Present Position and the Future.

To turn now from the details of the courses to look at the scheme as a whole and try to assess some of its achievements, there can be little doubt that the students and the Technical Colleges alike have gained much.

* A recommendation to this effect has been included in the revised (1952) edition of "Notes for the Guidance of Establishments for Further Education on the Arrangement of Courses for National Certificates in Applied Physics."

The Physics Departments of Colleges have profited in two main ways; firstly, industrial physicists with specialist knowledge and experience have come in as part-time lecturers and that is always valuable in technical education, and secondly, some firms and laboratories have helped in providing special pieces of apparatus which have been useful additions to the Department's equipment. In these ways a closer association between the College and industry has developed. There has been another gain, less easy to assess but nevertheless real, and that is a quickening of the life and spirit of the Departments themselves. Hitherto in many Technical Colleges the Physics Department has existed entirely as an ancillary department providing courses for the students of nearly every other Department in the College; for the Physics Department to have students of its own taking the National Certificate courses has been an invigorating experience.

As to the students their numbers, as noted earlier, are small but they can, inevitably, be divided into three groups. Firstly, there are those who have gained the Ordinary National Certificate and found their level there; they have acquired not only some useful knowledge but an introduction to workshop practice and laboratory arts which should see them embarked on a useful career in industry. Secondly, there are those who have proceeded to the Higher National Certificate but whose academic and other abilities are such that they are not likely to proceed further. They will be useful members of any group in a physics laboratory undertaking research or development work. Thirdly, there is the small group who have gained the Higher National Certificate and besides being good experimentalists have shown themselves capable of pursuing more advanced study in physics and mathematics. They will later take the Graduate Examination and thereby become corporate members of the Institute. They will take their place on the scientific staff of industry and will work alongside university-trained physicists on equal terms. Their further advancement will depend not a little on personal qualities but the highest ranks of the profession will be open to them.

The presence of these men in industry and in research laboratories is the only effective way of demonstrating the

value of these National Certificate courses. The quality of their work will both justify the introduction of the scheme and contribute to its expansion.

What then can be said of the future? It is clear that the National Certificate courses in applied physics are in the first stage of development and for a few years ahead we can only look to a process of consolidation and some expansion. This will depend not only on the continuing good work of teachers in Technical Colleges, who have already made a valuable contribution, but also on the type of new entrant industry is able to recruit and to guide into these courses.

The Board of the Institute is keen to further the courses and to do all it can to assist in their development. In September, 1951, it organised a conference at which there was a fruitful sharing of experience between teachers, assessors and industrial physicists. Others are likely to be held as need arises. It is also hoped that the Institute's new Graduateship examination and the new regulations for membership will attract more students to the Higher National Certificate courses. The Board has also arranged to publish a series of student monographs on aspects of physics with industrial applications which should be of great help to both teachers and students.*

Experience of National Diploma courses in other subjects would lead one to expect that a reasonable development would be the introduction of National Diploma courses in applied physics. Perhaps the time is not yet ripe for a decision about such full-time courses, but if the demand were sufficient it is clear that the major technical colleges which now offer degree courses in physics or organise courses in physics for degree students of engineering are well able to provide them.

Their experience with new courses for the Graduate Examination will be a useful guide. However developments of this kind are linked with decisions concerning the place of technical colleges in the national pattern of higher technological education which it would be inappropriate to discuss now. But it does seem obvious that some technical colleges should organise courses in physics of this type.

*The first four monographs will be published early in 1953.

REVIEWS OF BOOKS

Science and Hypothesis. By HENRI POINCARÉ. (New York: Dover Publications Inc.) Pp. xxvii + 244. Price \$1.25 paper cover edition, \$2.50 cloth edition.

Science and Method. By HENRI POINCARÉ. (New York: Dover Publications Inc.) Pp. 288. Price \$1.25 paper cover edition, \$2.50 cloth edition.

These reprints of English translations of two works by Henri Poincaré, originally published in French in 1903 and 1908 respectively, represent the mature thought of a noted savant who worked at the end of what may be termed the pre-relativistic and pre-nucleonic age of mathematical and physical science.

"Science and Hypothesis," introduced with a preface by Professor Larmor, covers subjects ranging from the nature of mathematical reasoning and non-Euclidean geometries to the theories of modern physics and electrodynamics. Much of this work seems surprisingly up-to-date, but even where it has been superseded by the current systematisation of knowledge, we are fascinated by the flashes of intuition and foresight contained in the argument.

The other volume, "Science and Method," has a preface by Bertrand Russell. This preface, in the paper bound edition does not appear in the usual place, but we may suppose

that part at least is included in the publisher's announcement on the inside of the paper cover. The author, in his own introduction, stated that he has collected various studies which are more or less directly concerned with scientific methodology. The chapters on the philosophy of mathematics and on logic contain much of which was controversial at the time and is still subject to dispute, but is none the less important and fundamental. To the physicist however the later chapters on mechanics and radium, mechanics and optics, mechanics and astronomy will prove the most interesting. On page 209 for example there is a most startling suggestion of atomic structure; light negative electrons rotating about a heavy positive electron, the whole being neutral.

Although taken as a whole these volumes are not to be considered current text-books, Poincaré's opinions must always be regarded with great respect; his masterly style, even in translation, is well worthy of study. These two reprints make available to a new generation of physicists the "natural philosophy" of the recent past as expounded by one of the greatest of its teachers.

The paper and print of the books are good and the economy of the paper-backed edition is reflected in the modest price.

F. H. GAGE

Mechanics and Properties of Matter. By R. C. Brown, B.Sc., Ph.D., D.Sc. (London: Longmans, Green & Co. Ltd.) Pp. ix + 276 + ix. Price 10s. 6d.

This book is the first volume of a four-volume Text-book of Physics intended to cover the requirements of such examinations as the Intermediate and the General Certificate of Education Advanced level, and as such it has, of course, many competitors. Let it be said at once that it should more than hold its own in this crowded field if solid virtue is accounted higher than glamour. Some experienced university lecturers have recently expressed their concern at the fact that many of those coming up to the university do not possess that sound knowledge of fundamentals which they could reasonably be expected to have. How far this criticism is valid is a matter for discussion but to those who accept it Dr. Brown's book

will be particularly welcome. He has set out avowedly to give a plain unvarnished account of the basic principles, resisting all temptations to include topics far better left for later study. There is nothing unusual in the general lines of development followed in the book but it reveals in many places the skill of an experienced teacher who has given much thought to questions of modes of presentation and who is well aware of the places where students find particular difficulty. Doubtless there will be those who would prefer here and there some different approach or emphasis but all who are concerned for the best interests of physics teaching will be grateful to Dr. Brown for the painstaking care he has devoted to the production of this book.

F. Y. POYNTON

OTHER PUBLICATIONS

The following books and reports have been received and are deposited in the Members' Room of the Institute's House:

The Soviet Union To-day (A Scientist's Impressions). By S. H. Manton, F.R.S. (London: Lawrence & Wishart Ltd.) Pp. 132. Price 5s. 0d.

Science in New Poland. By Jan Dembowski. (London: Lawrence & Wishart Ltd.) Pp. 50. Price 2s. 6d.

Seventh Report of the Nuffield Foundation (for the year ending 31st March, 1952). Pp. 162.

Science and Democracy. By Sir Henry Tizard. (Cambridge, Massachusetts, U.S.A.: The Massachusetts Institute of Technology). Pp. 34. Being the sixth annual Arthur Dehon Little Memorial Lecture at the Massachusetts Institute of Technology, November 1951.

International Council of Scientific Unions. Report of the Executive Committee 1951. Edited by Professor F. J. M. Stratton. Pp. 108.

Final Report of the Anglo-American Council on Productivity. September 1952. (London: Anglo-American Council on Productivity). Pp. 40. Price 3s. 6d.

MEMBER OF NOTE

John S. Forrest, M.A., D.Sc.

Dr. Forrest was educated at Hamilton Academy and Glasgow University; he graduated M.A. with honours in mathematics and natural philosophy and B.Sc. in pure physics in 1930.

His first appointment was as a mathematical physicist with the Central Electricity Board, working on problems arising in connection with the commissioning of the Grid system. He made a special study of high-voltage power transmission and played an active part in the development of 132 kV and, more recently, 275 kV transmission schemes in this country. In 1948 Dr. Forrest was awarded the D.Sc. degree for research on high voltage insulation leading to improved designs of insulators and the development of new insulation measuring instruments.

When the British Electricity Authority was formed in 1948 Dr. Forrest was appointed Director of the Authority's Research Laboratories at Leatherhead and Croydon. He also serves as Secretary of the Electricity Supply Research Council.

Elected a Fellow of the Institute in 1940, Dr. Forrest served on the Board 1945-49 and was Chairman of the Membership Committee in 1949. He still sits on that Committee and on the Finance Committee.

A Member of the Institution of Electrical Engineers, he has served on its Council and on its Section Committees. He has published various papers on insulation, lightning and transmission lines in the Institution's *Proceedings*. Also interested in meteorology, particularly in its applications, Dr. Forrest has served on the Council of the Royal Meteorological Society, and has been its Foreign Secretary. He was one of the founders of *Weather*.



THE REGISTER

ELECTIONS TO MEMBERSHIP

An asterisk (*) indicates transfer from another grade.

Fellows

- Coulson, Charles Alfred, M.A., D.Sc., Ph.D., F.R.S., Rouse Ball Professor of Mathematics, University of Oxford.
Hoare, Frank Ernest, M.Sc., Ph.D., Senior Lecturer in Physics, University of Leeds.

Associates

- *Benson, William, B.Sc., Research Officer, British Cotton Industry Research Association, Didsbury, Manchester.
Bradley, Benjamin, B.Sc., Senior Lecturer in Physics, Rotherham College of Technology.
*Evans, Henry Lewis, M.Sc., Research Officer, Division of Food Preservation, C.S.I.R.O., Australia.
Frisby, John Hollick, B.A., B.Sc., Senior Physics Master, King's School, Worcester.
Harrison, Ernest Raymond, B.Sc., Scientific Officer Grade II, Defence Research Laboratories, Victoria, Australia.
Hounam, Robert Fawcett, B.Sc., Senior Experimental Officer, Atomic Energy Research Establishment, Harwell.
James, Wilfred, B.Sc., Scientific Officer, British Ceramic Research Association, Stoke-on-Trent.
Jarvis, Henry Francis Thomas, B.Sc., Senior Lecturer in Physics, College of Technology, Bristol.
*Lowenthal, Gerhard Claus, B.A., B.Sc., Physicist Grade I, Defence Research Laboratories, Victoria, Australia.
McNeill, John James, M.Sc., Physicist, Defence Research Laboratories, Victoria, Australia.
*Massey, John Barlow, B.Sc., Assistant Physicist, Christie Hospital and Holt Radium Institute, Manchester.
Mykura, Helmut, B.Sc., Lecturer in Physics, University College of the West Indies, Jamaica.
Newman, Peter Colin, M.A., Scientist II, National Coal Board, Central Research Establishment, Stoke Orchard, Gloucestershire.
Nicol, Alexander Douglas Ian, B.Sc., Ph.D., Senior Physicist, B.S.A. Group Research Centre, Sheffield.
Nicolson, Phyllis, M.A., M.Sc., Ph.D., Lecturer in Physics, University of Leeds.
*Pattison, John Robert, B.Sc., Scientific Officer, British Iron and Steel Research Association, London.
Roberts, John, B.Sc., Lecturer in Physics, Wigan and District Mining and Technical College, Wigan.
Quayle, Irad Stanley, B.Sc., Head Master, Secondary Technical School, Salford.
Richards, Richard Thomas Dennis, B.A., B.Sc., Scientific Officer, Wool Industries Research Association, Leeds.
*Sprinks, Maurice Edward, B.Sc., Ph.D., Scientific Officer, Royal Naval Scientific Service, Cosham, Hants.
Thomas, David Gurney Arnold, M.A., Scientist II, National Coal Board, Central Research Establishment, Stoke Orchard, Gloucestershire.
Thorncliffe, Gordon Hugh, B.Sc., Scientific Officer, Wool Industries Research Association, Leeds.
Townsend, Malcolm W. H., B.A., Principal Scientific Officer (Head of Weaving Department), Wool Industries Research Association, Leeds.
- Graduates*
- Adair, Robin, B.Sc., Engineer, English Electric Co., Luton Airport, Beds.
Alpin, Leonard, B.Sc., Senior Technical Assistant, Hoover Ltd., Greenford, Middlesex.
Atherton, Arthur, B.Sc., Works Assistant, Ministry of Supply.
Baker, Philip Stanley, B.Sc., Graduate Experimental Staff, Research Laboratories of the General Electric Co. Ltd., Stanmore, Middlesex.
Bennett, Joe, B.Sc., Assistant Research Engineer, Metropolitan-Vickers Electrical Co., Ltd., Manchester.
Burchard, Catherine Joan, B.Sc., Engineer, E.M.I. Engineering Developments Ltd., Middlesex.

- Calow, John Robert Billson, B.Sc., Scientific Officer, British Iron and Steel Research Association, London.
Cartz, Louis, B.A., M.Sc., Research Student, University College, London.
Coe, Roger Frank, B.Sc., Research Assistant, University of Birmingham.
Collington, Derek John, B.A., Research Student, University of Oxford.
Cooke, Daphne Sheila, B.Sc., Research Assistant, University of Bristol.
*Cooper, Raymond, B.Sc., Research Student, University of Bristol.
*Cowan, Ian Roy, B.Sc., Temporary Worker, Rothamsted Experimental Station, Harpenden, Herts.
Dempsey, Henry Eugene, B.Sc., Research Engineer, Serck Radiators Ltd., Wolverhampton.
Dodd, David Seddon, B.A., Scientific Officer, British Ceramic Research Association, Stoke-on-Trent.
Duffin, William John, M.A., Lecturer in Physics, University College, Hull.
Durrant, Neville Frederick, B.Sc., Junior Physicist, The Micanite and Insulator Co. Ltd., London.
Ellingham, Kenneth Leopold, B.Sc., Research Student, Department of Textile Industries, University of Leeds.
Fayers, Frank John, B.Sc., Research Student, University of Reading.
Ferrier, William George, B.Sc., Research Student, University College, Dundee.
Fortune, Ronald Denis, B.Sc., Research Trainee, Metropolitan Vickers Electrical Engineering Co. Ltd., Manchester.
Gilbert, Joseph, B.Sc., Engineer, Decca Radar Ltd., London.
Hanson, Alfred Wallace, M.A., B.A.Sc., I.C.I. Fellow, College of Technology, Manchester.
Hardwick, Ivan Roy, B.Sc., Scientist III, National Coal Board, Middlesex.
Harris, Derek Vincent, B.Sc., Science Master, Pontypridd Technical School, Rhymfelin.
Harrison, Frederick William, B.Sc., Research Student, University of Leeds.
Hartnell-Bewis, Michael Carl, B.Sc., Postgraduate Student, University College, London.
*Huggan, Michael Ainsley, B.Sc., Physicist, G. D. Peters & Co. Ltd., Slough.
Hymans, Anthony Jack, B.Sc., Mathematical Physicist, English Electric Co. Ltd., Luton.
Jenkinson, Arthur Eric, B.Sc., Research Physicist, Dunlop Rubber Co., Ltd., Birmingham.
Laurie, Mary Jean Elizabeth, B.Sc., Research Physicist, General Electric Co. Ltd., Wembley, Middlesex.
Leckie, Marion Isabel McGregor, B.Sc., Assistant Technical Officer, Imperial Chemical Industries Ltd., Manchester.
*Levine, Martin, B.Sc., Research Engineer, E.M.I. Engineering Developments Limited, Middlesex.
Lum, John Garbett, B.Sc., Physicist, Sir W. E. Armstrong Whitworth Aircraft Ltd., Coventry.
Milligan, Robert, B.Sc., Lecturer in Physics, Dundee Technical College.
Milne, Honor Rosemary, B.Sc., Technical Officer, Ferodo Ltd., Stockport, Cheshire.
Morgan, Frederick Richard, B.Sc., Research Student, University of Southampton.
Nicol, William Stewart, B.Sc., Technical Assistant, Installation Development Department, Bristol Aeroplane Co. Ltd., Bristol.
Northwood, David, B.Sc., National Service.
Palmer, Bryan Albert, B.Sc., Cathode Ray Tube Engineer, Standard Telephones and Cables Ltd., London.
Partridge, Alan Torrington, B.Sc., A.R.C.S., Physicist, Mulard Radio Valve Co. Ltd., Redhill, Surrey.

Pinnock, Peter Rowley, B.Sc., Research Graduate, College of Technology, Manchester.
 Preece, Keith Elidyr, B.Sc., Research Engineer, Marconi's Wireless Telegraph Co. Ltd., Chelmsford.
 Roberts, Christopher Joseph Vinnall, B.A., Temporary Senior (Research Laboratory), Kodak Ltd., Harrow, Middlesex.
 Roberts, William Thompson, M.Sc., Research Student, Crystallography Department, Cavendish Laboratory, Cambridge.
 Slater, Arnold Henry, B.Sc., Assistant Engineer, English Electric Valve Co. Ltd., Chelmsford.
 *Snell, Raymond William, B.Sc., Instructor Lieutenant (Meteorological Officer), Royal Navy.
 Stokes, Horace John, B.Sc., Technical Officer, Imperial Chemical Industries Ltd., Birmingham.
 Thomas, Kenneth, B.Sc., Research Student, University College of North Wales, Bangor.

*Townsend, William Godfrey, B.Sc., Research Student, University College of Swansea.
 Woodyatt, William Neville, B.Sc., National Service.
 Zacharov, Basil, B.Sc., Research Student, The Polytechnic, Regent Street, London.

Subscribers

Balashov, Vladimir, Research Assistant, University of Leeds.
 de Leiris, Louis Henri, Ingenieur General du Genie Maritime, Paris.
 Lavavasseur, Gustave Emile Louis, Electronic Engineer, Laboratoire Central des Services Chimiques de l'Etat, Paris.
 Oughton, Beryl Mary, Research Assistant, Chemical Crystallography Laboratory, University Museum, Oxford.
 Stringer, Jack Eldon Crawford, Senior Research Assistant, Vickers-Armstrong Ltd., Newcastle-on-Tyne.

APPOINTMENTS VACANT

The inclusion of particulars of a vacancy must not be taken to imply that the Institute necessarily approves of the terms offered or that might be offered. Candidates should satisfy themselves that these are satisfactory, and they may always refer to the Institute for advice.

SCIENTISTS

Rowntree & Co. Ltd. has vacancies in the Production Departments of overseas associated companies for male **science graduates** under 30 years of age. Initial training at York will be provided before proceeding overseas to either Canada, Australia, South Africa or Eire. The initial salary will be according to age and qualifications and there is a pension scheme available in all cases. Applications, stating age, qualifications and experience to Staff Officer (Men), The Cocoa Works, York.

Ferranti Ltd., Moston Works, Manchester, have a vacancy for a **Senior Valve Engineer** in their Radio Valve Research Laboratory in connection with the development of V.H.F. and microwave amplifier valves. Applicants should have a good degree in physics or engineering with experience in V.H.F. valve development.

The salary range is £800 to £1,200 per annum and the Company has a Staff Pension Scheme. Application forms may be obtained from Mr. R. J. Hebbert, Staff Manager, Ferranti Ltd., Hollinwood, Lancs. Please quote reference VG.

Fielden (Electronics) Ltd., require a **physicist** for development and application of novel instrument techniques. Previous experience with industrial instrumentation an advantage. Knowledge and interest to be widely based and to include general electronic theory. Apply in writing, stating age and salary required, to Chief Engineer, Paston Road, Wythenshawe, Manchester.

A vacancy exists at the **Dunlop Research Centre**, Birmingham, for a **physicist** with a good honours or higher degree to carry out fundamental research on textiles. Previous experience desirable but not essential. Application in writing, quoting reference J.M.5 and giving details of age, qualifications and experience to: Personnel Manager, Dunlop Rubber Co. Ltd., Fort Dunlop, Erdington, Birmingham, 24.

The Royal Technical College, Glasgow (in affiliation with the University), have a vacancy in the Department of Natural Philosophy for a **Lecturer** in Physics. Candidates should have an Honours degree with special qualification in electronics, electron microscopy, photo-elasticity, or other

branch of applied physics an advantage. Successful applicant to participate in advanced courses for College Associateship in Applied Physics. Salary scale £600 x £50 - £1,150. Application forms from the Secretary of the College.

Research Division Appointment. Applications are invited from graduate physicists or engineers, between the ages of 27 and 40, for appointment as **Departmental Manager** in charge of Physics Laboratory and Engineering Test House. Successful candidate will be required to direct research into the nature of friction, to design large scale test machines for measuring friction, and to carry out applied research of various braking problems. Preference given to those with experience in both physics and engineering fields. Knowledge of friction and statistical methods an added qualification. Excellent prospects for a man with energy and initiative. Salary according to qualifications and experience. Pension scheme.

Applications in confidence, giving full details, including age, qualifications, experience in chronological order, and salary required, to Personnel Manager, **Ferodo Limited**, Chapel-en-le-Frith, Via Stockport, Cheshire.

Young Science graduate (in physics or metallurgy preferred) wanted for industrial research into the methods of radiography and radioactive tracers. Good prospects. Apply to the Personnel Manager, **Hadfields Ltd.**, East Hecla Works, Sheffield, 9.

ASSISTANT

The Foot and Mouth Disease Research Institute, Pirbright, Surrey, invite applications for a post of **Assistant (Scientific)** at a salary of £341 per annum at age 25, thereafter rising by eight annual increments to a maximum of £476 per annum. The post offers opportunities to work with the electron microscope and ultracentrifuge and candidates should preferably have had experience in Bio-Physical or Physical-Chemical Laboratories. The post will be superannuable after completion of a probationary period of six months. Housing accommodation can be made available at a rental at present assessed at £40 per annum.

Applications, stating age, qualifications and details of present and past appointments, and accompanied by the names of three persons to whom reference may be made should be addressed to the Secretary not later than 20th January, 1953.